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(71) Applicant *(for all designated States except US)*: **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **RAITOLA, Mika** [FI/FI]; Nissnikuntie 7 B 5, FIN-02430 Masala (FI).

(74) Agents: **RUUSKANEN, Juha-Pekka** et al.; Page White & Farrer, 54 Doughty Street, London WC1N 2LS (GB).

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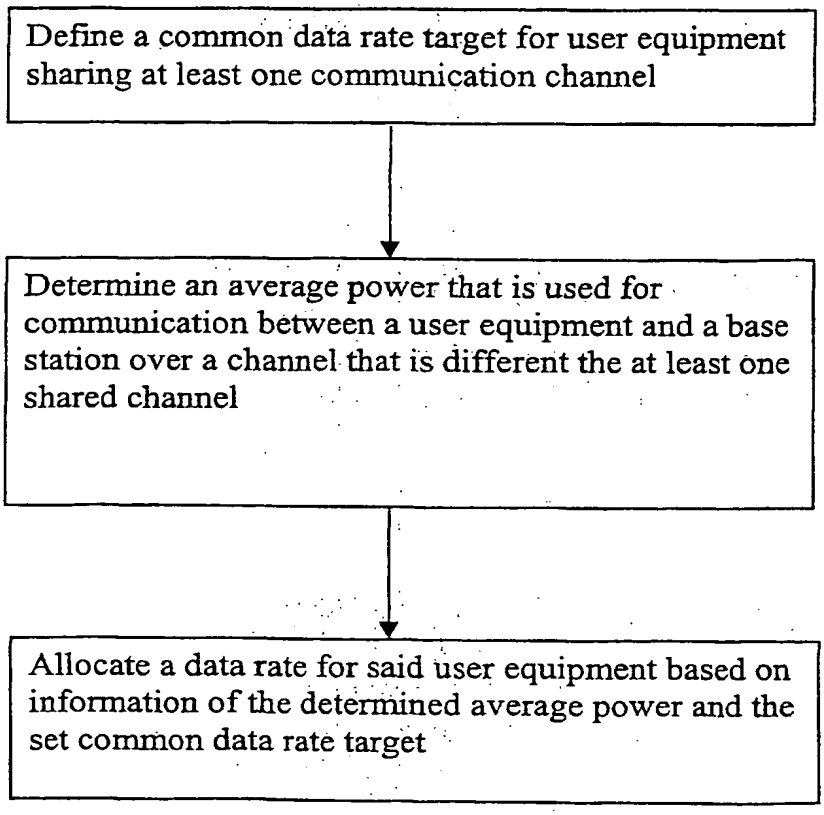
(54) Title: ALLOCATION OF SHARED CHANNEL DATA RATES IN A COMMUNICATION SYSTEM



(57) Abstract: A method for use in a communication system as well as a communication system and a base station for a communication system are disclosed. In the method a common data rate target is defined for user equipment that may share communication channels when communicating with the base station. An average transmission power used for communication between the user equipment and said station is defined. A data rate allocated for said user equipment may then be set based on information of the determined average transmission power and the common data rate target.

WO 02/45291 A1

ALLOCATION OF SHARED CHANNEL DATA RATES IN A COMMUNICATION SYSTEM

Field of the Invention

The present invention relates to channels in a communication system, and in particular, but not exclusively, to adaptation of radio channels.

Background of the Invention

A communication system typically operates in accordance with a given standard or specification which sets out what the various elements of the system are permitted to do and how that should be achieved, i.e. the technology on which the communication is based on. A communication system may comprise one or more communication networks. A communication network is a cellular network. A cellular system consists of access entities typically referred to as cells, hence the name cellular system.

A feature of the cellular system is that it provides mobility for the mobile stations subscribing thereto. That is, the mobile stations are enabled to move within the cell and from a cell to another cell and even from a cellular network to another cellular network if both of the networks are compatible with the standard the mobile station is adapted to.

Examples of the different cellular standards and/or specifications include, without limiting to these, standards such as GSM (Global System for Mobile communications) or various GSM based systems (such as GPRS: General Packet Radio Service), EDGE (Enhanced Data rate for GSM Evolution or CDMA or WCDMA (Code Division Multiple Access or Wideband CDMA) based 3rd generation telecommunication systems such as the Universal Mobile Telecommunication System (UMTS), i-Phone, IS-95 and IMT 2000 (International Mobile Telecommunication System 2000) and so on. It should be appreciated that the terminology used in the different standards may vary from each other.

levels may be set by a base station and/or a network controller or even by a mobile station, depending on the application. In addition to controlling the power levels, the control functions may comprise, among other things, control of the allocated bitrates for data transmissions on the transport channels of the communication system and so on.

The selection of the bitrate and power of the physical downlink shared channel (PDSCH) can be made rather freely. One reason for this is that in the downlink the user equipment does not have to participate in procedure of bitrate or power selection. This is done in the network side, e.g. by the base station or the radio network controller. However, the selected transport format needs to be signalled to the mobile station and thus the appropriate network element informs the user equipment what bitrate it is using for the downlink. Otherwise the user equipment would not know how to decode the received signal. The information can be transmitted by using so called downlink transport format indication bits.

In applications that are capable of transmitting multimedia over wireless interfaces, such as the third generation communication systems, the downlink is considered at present to be the most restrictive transmission direction. This is believed to be so mainly because the traffic is typically asymmetric in the present multimedia applications. That is, in most, but not all, applications the downlink can be substantially more heavily loaded than the uplink.

A possibility to improve the downlink capacity is to use a suitable link adaptation mechanism. The link adaptation mechanism refers in general to a mechanism that allows provision of different data transmission capacity for different users. For example, data may be transmitted with higher bitrates towards those mobile users who are close to the base station and with lower bitrates towards those mobile users who are more remote. Link adaptation is typically used to enhance radio resource management (RRM) functions. The radio resource management may be based on various parameters, such as the measured power levels in the cell and/or interference in the cell. However, the inventor has found that with a shared channel and bursty data these parameters used for the radio resource management may

said user equipment; and control means for allocating a data rate to be provided for said user equipment based on information of the determined average power and the common data rate target.

In a more specific embodiments of the invention, the allocated data rate depends on the distance between the user equipment and the station, the distance being determined based on the determined average power. The dependency may be such that if the user equipment is located closer to the station than another, more remote user equipment, said one user equipment is provided with a higher data rate that said more remote user equipment. A user equipment determined to be substantially close to the base station may be provided with a data rate that is the common data rate target or substantially close to the common data rate target.

The average power may be determined based on information associated with a dedicated channel that associates with the communication channel used by the user equipment. The average power may alternatively or in addition be determined based on information associated with a Perch channel. The information may comprise the power of said channel.

The data rate target may be defined when the network is planned or upgraded. The data rate target may be adaptive.

The data rate may be adjusted by a controller of the station and/or by a controller of the user equipment. The average transmission power may be the average transmission power by which the station transmits towards the user equipment. The average power may alternatively be the average power in which the station or the user equipment receives.

The embodiments of the invention provide a solution for link adaptation. The solution may be especially advantageous for adaptation of shared channels. The embodiments may reduce interference fluctuations and may thus improve the overall system performance. The embodiments may improve user throughput and overall data transmission capacity. It is, for example, possible to provide those

The cell of Figure 1 can be seen as to be divided to different bitrate zones based on the distance from the base station BS. Adjustment of data transmission rates between the base station BS and the mobile stations MS1 to MS4 may be based on the required transmission power between the respective mobile station and the base station. The adjustment may be accomplished under the control of the controller 10 of the base station BS. If same bitrate is used for the data transmission, the more far away a mobile station is the more power is needed. On the other hand, if a higher bitrate is to be used more power is needed than with a lower bitrate.

When the system tries to keep the power at the same level for all mobile stations, the far away mobile stations will get lower bitrates than the mobile stations that are closer to the base station. Thus, virtually the cell can be seen as divided into several zones 1 to 4 such that different bitrates are used in each of the virtual zones.

Instead of adjusting the data rates directly based on the location of the mobile stations MS1 to MS4, a dependency between the data rate and the distance from the base station BS can be based on an appropriate parameter indicative of the distance. The parameter may be linear or logarithmic, depending on the application.

In a preferred embodiment of the present invention an average base station transmission power is measured. The average transmission power used for each mobile station is preferably measured by the base station BS. The measurement may be handled under the control of the controller entity 10. Based on the average transmission power, it is possible to determine how close (or far) a mobile station is located relative to the base station. The data transmission rates over the wireless interfaces are then adjusted based on the distance that was determined based on the measured average transmission power. The transmission data rate may be based on the measured average transmission power of a certain link to a certain mobile station.

For those users who are relatively close to the base station BS the bitrate may be set to be substantially close to a set bitrate target value, such as PtxTargetDSCH. Those mobile stations which are substantially far away, such as the mobile station MS4, the bitrate may be set to be in a substantially lower level than what is provided for the mobile stations closer to the base station.

The data transmission rate i.e. the bitrate is defined based on information of the average transmission power in at least one other channel. The average transmission power can be measured e.g. from the associated dedicated channel (DCH). The DCH can be kept running for a much longer time than the DSCH since the DCH bitrate will in most instances be lower than what the DSCH bitrate is. The transmission power could also be measured from a so called Perch channel before DSCH access. The Perch channel refers to a common pilot channel, in which the power is constant. The Perch channel can also be measured by all mobile stations in a cell. It is used for various measurements, for example measurement associated with handovers, signal reception and so on.

In general, the bitrate of a user in a dedicated shared channel (DSCH) may be set, for example, according the following equation:

$$bitrate_{DSCH} = \frac{Ptx_{DSCH} \times EbN0_{DCH}}{Ptx_{DCH} \times EbN0_{DSCH}} \times bitrate_{DCH}$$

In the above equation the Ptx values are the transmission powers of the dedicated channel (DCH) and dedicated shared channel (DSCH) and the EbN0 values correspond the EbN0 values of the respective channels. The term 'EbNo' refers to a connection quality parameter value that is used for defining a signal energy / noise ratio for a connection. The EbNo value may be measured for the connection or the EbNo value may be obtained otherwise from the system, such as based on parameterisation in accordance with a cell average (so called 'EbN0_planned'). The distance is relative to the transmission power needed to reach a certain mobile. Thus the term Ptx_DCH depends on the distance.

(frequency division duplex) transmission mode and the SDD (space division duplex) transmission mode. Each of these method may be used for the communication in the 3rd generation communication systems, such as the UMTS.

The average power is typically determined for the transmission power of the base station, for example by means of the controller 10. However, since a mobile station may also transmit in different power levels, it is also possible to base the data rate adjustment on the average transmission power of the mobile station. These operations may be controlled by means of a controller provided in association with the mobile station, such as by means of a controller 11 of the mobile station MS4 of Figure 1. These two alternatives are available for both the uplink and downlink adjustment. In addition, the average power may be based on determination of both the uplink and downlink power between a base station and a mobile station.

It should be appreciated that whilst the exemplifying embodiments of the present invention have been described in relation to mobile stations, embodiments of the present invention are applicable to any other suitable type of user equipment. It shall be appreciated that the radio interface may be referred to as Iub interface. It shall also be appreciated that in some standards the base station may be referred to differently, such as by term 'Node B'.

Furthermore, the embodiments of the present invention have been described in the context of a WCDMA system. This invention is also applicable to any access techniques including code division multiple access, frequency division multiple access, time division multiple access and space division multiple access as well as any hybrids thereof.

It is also noted herein that while the above describes exemplifying embodiments of the invention, there are several variations and modifications which may be made to the disclosed solution without departing from the scope of the present invention as defined in the appended claims.

7. A method as claimed in any of claims 1 to 4, wherein the average power is determined based on information associated with a Perch channel.

8. A method as claimed in any of claims 5 to 7, wherein the information comprise the power of said channel.

9. A method as claimed in any preceding claim, wherein the data rate target is defined when the network is planned or upgraded.

10. A method as claimed in any preceding claim, wherein the data rate target is adaptive.

11. A method as claimed in claim 10, wherein the data rate target is adapted based on information regarding the capacity of the station.

12. A method as claimed in claim 10 or 11, wherein the data rate target adaptation is accomplished in predefined intervals.

13. A method as claimed in claim 12, wherein the data rate target is kept constant for a predefined number of frames before allowing adaptation thereof.

14. A method as claimed in any preceding claim, wherein the average power is an average power in downlink direction.

15. A method as claimed in any preceding claim, wherein the average power is an average power in uplink direction.

16. A method as claimed in any preceding claim, wherein the data rate is adjusted by a controller of the station.

17. A method as claimed in any preceding claim, wherein the data rate is adjusted by a controller of the user equipment.

24. A communication system as claimed in claim 22 or 23, wherein the data rate is adjusted by a controller of the station.

25. A communication system as claimed in any of claims 22 to 24, wherein the data rate is adjusted by a controller of the user equipment.

26. A communication system as claimed in any of claims 22 to 25, wherein the station is a base station of a cellular system and the user equipment is a transceiver station capable of communicating with the base station via a wireless interface.

27. A base station for a communication system, comprising:

transmitter means for transmitting towards a user equipment over at least one communication channel shared with at least two user equipment;

control means for defining a common data rate target for all those user equipment that use the at least one shared communication channel;

means for determining an average power that is used for communication towards said user equipment; and

control means for allocating a data rate to be provided for said user equipment based on information of the determined average power and the common data rate target.

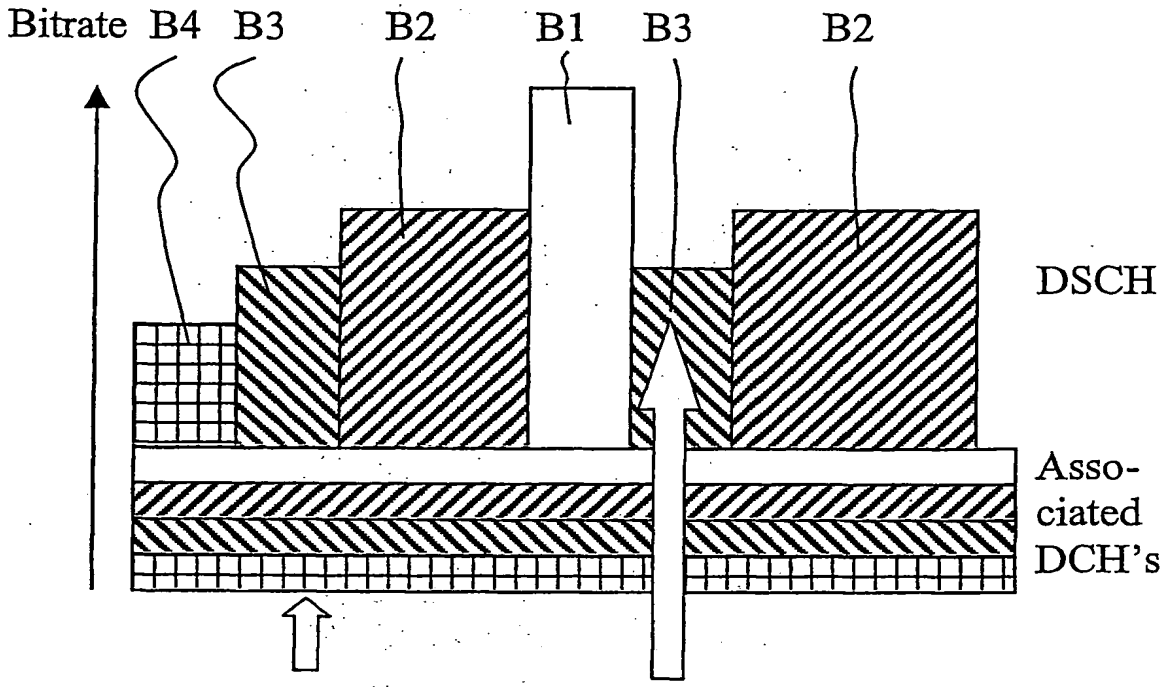

Bitrate
B4
B3
B2
B1
B3
B2
DSCH
Asso-
ciated
DCH's
DCH bitrate
is constant
DSCH bitrate
depends on location

Fig. 2

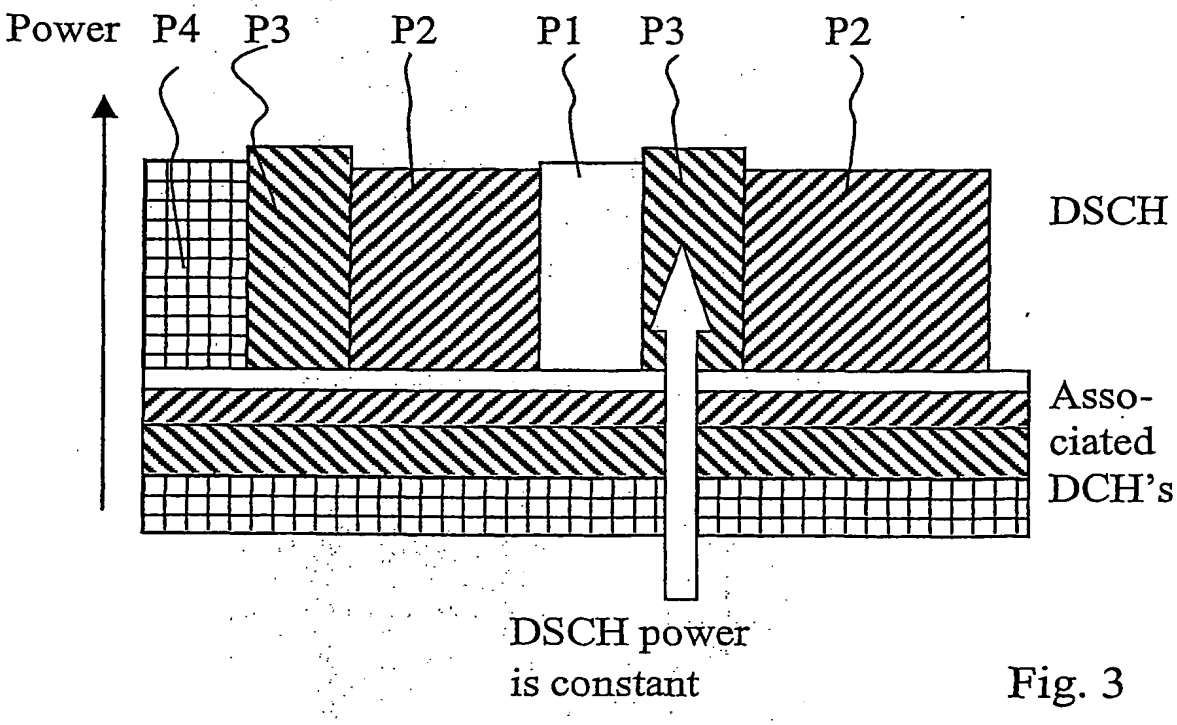

Power
P4
P3
P2
P1
P3
P2
DSCH
Asso-
ciated
DCH's
DSCH power
is constant

Fig. 3

INTERNATIONAL SEARCH REPORT

Int mal Application No
PCT/EP 01/11329

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/005 H04L1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04B H04L H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 734 967 A (STEWART KENNETH A ET AL) 31 March 1998 (1998-03-31) abstract; figure 4 column 2, line 63 -column 3, line 55 column 5, line 27 -column 6, line 18 claims 1,3,5,7,8	1-27
P,X	WO 01 11815 A (ATHEROS COMMUNICATIONS INC) 15 February 2001 (2001-02-15) abstract; figures 1,2 page 2, line 26 - line 30 page 4, line 14 - last line page 5, line 28 -page 7, line 12 claim 1	1-27

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
15 January 2002	24/01/2002

Name and mailing address of the ISA	Authorized officer
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Form PCT/ISA/210 (second sheet) (July 1992)

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